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Refuge utilization and nature of relationships among individuals in the eastern rockfish Sebastes taczanowskii (Scorpaeniformes, Sebastinae)

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REFUGE UTILIZATION AND NATURE OF RELATIONSHIPS AMONG INDIVIDUALS IN THE EASTERN ROCKFISH SEBASTES TACZANOWSKII (SCORPAENIFORMES, SEBASTINAE)

By V.E. Gomelyuk, V.P. Leunov and A.I. Markevich

The eastern rockfish Sebastes taczanowskii (Steindachner) is one /307 of the numerous and widely distributed species of fishes that inhabit the upper levels of the sublittoral of the Sea of Japan in Soviet Primor'e In the summer, during the day, groupings of eastern rockfish that include from several hundred to several thousand specimens, are found in the regions of boulder talus, craggy outcrops, underwater caves and grottoes at depths of 4 to 20 m. As shelters, the fish make use of crevices in the rocks, spaces between boulders, and overhanging rocks. At sunset, the schools of rockfish move to the shallows where they feed intensively during the night (Gomelyuk et al., 1985). Preliminary data, obtained by observation of individually tagged specimens, have shown that together with fish which keep permanently to a definite territory during the day and are registered in the same places for several months, there are also those which show slight or virtually no attachment to a particular shelter. For a more detailed study of the peculiarities of the utilization of shelters by the

*The numbers in the right-hand margin indicate the corresponding pages in the original. - Transl.

eastern rockfish in the daytime, an investigation was done in a trap which was placed near the natural habitat of this species of fish. The purpose of the investigation was to study the degree of attachment of different fish to the refuges, as well as the interrelationships arising between the fish when using the same refuge.

The work was done in August-September, 1984, in the bay of Bol'shoi Pelis I. (Peter the Great Bay, Sea of Japan). The trap was installed at a depth of 5 m on sandy bottom and consisted of a cube with 5 m sides, the four lateral faces of which were wrapped in net webbing with a 19 mm mesh. The upper part of the device was kept afloat on the surface of the water using floats, the lower part was solidly attached to the bottom with boulders. The trap was kept in place with a system of braces with weights. Twelve asbestos cement pipes with a diameter of 15 cm and a length of 1 m each were lowered onto the bottom of the cage in checkerboard fashion, so that the rockfish could use them as shelters.

The fish were caught by trap net, individually tagged with pictographic tags and the covers on the right and left sides of the body were scraped and the scrapes were greased with a solution of silver nitrate after Harshbarger (1979). In all, 21 eastern rockfish specimens were placed in the trap. Observations on the distribution of the fish were done daily (in the first 7 days after occupying the trap), and then at 4 day intervals from 3 to 5 times a day in the daytime using diving technology. It was noted in a 30 minute period which individuals were situated in a given pipe or very close to it, and which fish were swimming in the water layer and which kept to the sides and corners of the trap. Over the whole period of work, 50 such half-hour counts in all were done. The fish in the trap

were fed with cut-up fish and mollusks. in addition, they ate small crustaceans and fish fry which penetrated into the trap through the net webbing.

In processing the results, we calculated for each pipe the average number of fish which used it during the period of observations (M_p). We calculated for each specimen the "frequency" indicator by the formula B= Y/H X 100%, where Y is the number of times a fish was detected at one of the 12 pipes, H is the number of counts. The degree of attachment of a /309
fish to a particular pipe was expressed by a number calculated by the formula Y_k/Y X 100%, where Y_k is the number of cases that the given fish was detected at any of the 12 pipes. An individual which in addition to a high "frequency" indicator (B ≥55%) also showed a high degree of attachment to a particular pipe (not lower than 35%) was considered a "resident" of a given pipe-refuge. For the resident fish, we determined the ratio Po/Pp, where Po is the number of cases when the resident was situated alone in the pipe; Pp - when other specimens were situated there together with it.

Comparison of the behavior of the fish contained in the trap with those living in a natural grouping showed that the restriction of freedom of movement created by conditions in the trap on the whole had little effect on the experimental fishes.

After a brief period of adaptation, on the order of 3 days, during which the rockfish kept in a school in the water mass, they investigated the walls and floor of the trap and also the pipe-shelters; the rhythms of their behavior ceased to differ from those of the fish in an adjacent natural grouping. By day, the rockfish in the trap kept to the pipe-shelters, by night they left the refuges and concentrated at the wall of the trap which faced the shore of the bay.

TABLE 1

Frequency of occurrence (%) of different eastern rockfish individuals in the pipe-shelters in the experimental trap.

Номер рыбы 1	Номера труб 2												Вне труб 3
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1	—	—	—	—	—	—	—	—	—	3,7	74,0	3,7	18,6
2	—	—	—	—	—	—	—	—	70,3	3,7	3,7	—	22,3
3	66,6	7,4	—	—	—	—	—	—	—	3,7	—	—	22,3
4	—	—	—	—	—	3,7	—	3,7	14,8	—	48,1	—	29,7
5	40,7	7,4	3,7	—	—	—	—	—	37,0	7,4	—	—	3,8
6	7,4	3,7	18,5	—	—	—	3,7	37,0	11,1	3,7	—	—	14,9
7	3,7	7,4	11,1	18,5	—	—	3,7	7,4	3,7	—	7,4	7,4	29,7
8	—	—	3,7	—	—	7,4	—	11,1	7,4	14,8	11,1	14,8	29,7
9	29,6	3,7	3,7	—	—	—	3,7	3,7	—	—	—	—	33,4
10	7,4	14,8	—	—	3,7	3,7	3,7	—	—	25,9	—	—	40,8
11	—	—	—	—	—	3,7	3,7	3,7	3,7	—	22,2	22,2	40,8
12	—	—	—	—	—	—	—	18,5	3,7	18,5	3,7	7,4	48,2
13	—	3,7	—	—	—	25,9	7,4	2	3,7	—	—	7,4	51,9
14	—	—	—	—	—	—	3,7	2	—	3,7	18,5	14,8	59,3
15	—	—	3,7	3,7	3,7	3,7	7,4	3,7	3,7	—	7,4	—	63,0
16	3,7	—	—	—	—	11,1	—	—	7,4	7,4	—	—	70,4
17	3,7	3,7	3,7	7,4	—	—	—	—	—	—	—	—	81,5
18	—	—	—	—	3,7	—	—	—	—	11,1	3,7	—	81,5
19	—	—	—	—	3,7	3,7	—	3,7	—	3,7	—	—	85,2
20	—	—	7,4	3,7	—	—	—	—	3,7	—	—	—	85,2
21	—	—	—	—	7,4	—	—	—	—	3,7	—	—	88,9

Key : 1 number of fish; 2 - number of pipe; 3 - outside the pipes.

TABLE 2

Nature of utilization of different pipe-refuges by eastern rockfish in experimental trap.

№ трубы 1	P_o/P_p**	M_p, экз. 2	lim, экз. 2	№ трубы 1	P_o/P_p**	M_p, экз. 2	lim, экз. 2
1*	0,27/0,09	1,5	0—4	7	0,44	0,8	0—2
2	—	0,7	0—2	8	—	0,33	0—2
3	—	0,4	0—2	9*	0,36/0,10	1,4	0—3
4	—	0,7	0—2	10	—	1,1	0—4
5	—	0,2	0—1	11	0,4	1,6	0—3
6	—	0,7	0—2	12	—	1,0	0—3

Key: 1 - no. of pipe; 2 - spec.

*Two "residents" were using the pipe.

**Po is the estimate for one "resident", Pp is the estimate for the other "resident".

The degree of attachment of the fish to different pipes varied (Table 1). Despite the quite obvious, to our view, homogeneity of conditions in the trap and slight differentiation of any factors that might be important to the fish, given the small dimensions of the trap, the pipes differed in the number of fish which used them as a refuge (Table 2).

Of the 21 eastern rockfish specimens placed in the trap, only 6 could be considered residents, but there were two residents each in pipes I and IX (Table 2). We never observed clashes between the residents of the same pipe, while at the same time, these fish sometimes drove away from their refuges individuals swimming in from adjacent territories. At the same time, some other fish, even those which were not residents, did not provoke aggressive reactions from them. The fish in the natural grouping behaved in a similar manner, sometimes driving away some individuals from

the crevices which they occupied and "tolerating" the presence of others, although on the whole, we observed aggressive clashes very rarely in this species. In all the 50 half-hour observations, only 12 cases of attacks of some fish on others were noted. Half of these attacks were made by one and the same individual and in 2/3 of the cases this resident (No 2) showed aggressivity in relation to two particular fish, without attacking others. The other resident specimen in two of the attacks noted attacked one and the same fish. It is important to note that in not a single case was an individual living in the same pipe subjected to attack.

The next and most numerous group were the "migrant" fish, which were characterized by a rather high (69.3 - 37%) frequency (B_c) and a low attachment to any of the pipes used. All the specimens which migrated among the pipes, could be found in 5-9 refuges at different times (Table 1). They did not display aggressivity to other specimens, but some of them were subject to attacks by residents.

Four individuals (No 17 - 21) made least use of the pipes as shelters during the day. It seems to us that this was a varied group. It included fish which suffered from the catching, tagging and maintenance in the trap, as well as those which used the spaces along the walls of the trap and its corners instead of the pipes as refuges and which were thus apparently in conditions which were far from optimal for the eastern rockfish in the daytime.

The fish which made up the resident group were on average larger than the other individuals (Table 3); the last group had the smallest body dimensions. The migrants occupied an intermediate position; the differences are reliable to $p < 0.001$ after Student. However, the body length

of resident No 5 was smaller than the average for the group of migrants, and the individuals with the lowest B (frequency) indicator, included a fish whose dimensions surpassed the average for both the residents and the migrants (No. 19).

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TABLE 3

Natural tip length (NTL) of eastern rockfish with different nature of utilization of shelters in the experimental trap.

Показатель 1	«Резиденты» 2	«Кочующие» 3	«Стрессированные» 4
5 Число рыб, экз.	6	10	5
$\bar{x} \pm M_{\bar{x}}$	193±2,65	173,5±1,35	156,4±2,57
σ	6,48	4,28	5,74
CV	0,035	0,024	0,036

Key: 1 - indicator; 2 - "residents"; 3 - "migrants"; 4 - "stressed"; 5 - number of fishes.

Comment. The difference in the average values among all three groups is statistically reliable at p 0.01.

In our view, these results show that the organization of groupings in the eastern rockfish in the daytime in the summer cannot be reduced to territoriality in the form in which most investigators define it (Dewsbury, 1981). In the case of clearly pronounced territoriality, one could expect all 12 pipe-shelters to be occupied by 12 individuals which would actively protect their allotments from all intruders without exception. The entire population of the trap in such case would break down into two groups - those having territorial areas and those not having them. One

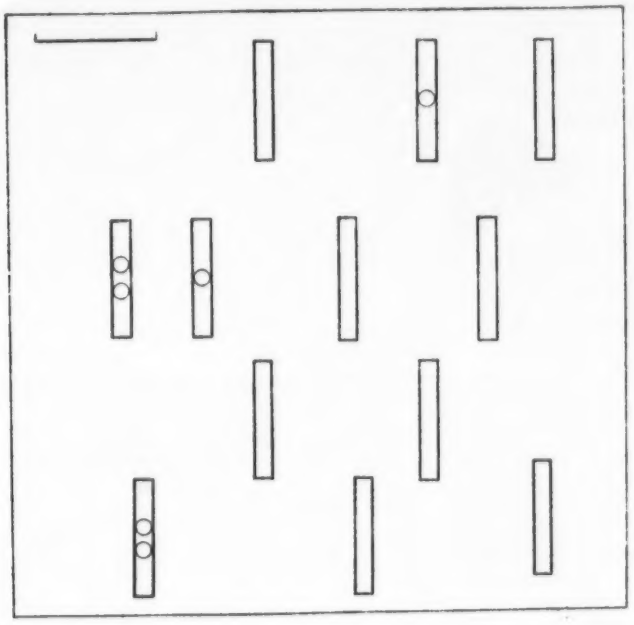

Diagram of the arrangement of pipes on the bottom of the experimental trap. The circle within a pipe indicates the presence in it of a "resident" (or "residents") - fish that are encountered in this pipe substantially more often than in others. The Roman numeral is the number of the pipe /sic!/ Scale - 1 m.

of the alternatives to strict territoriality could have been the formation of accumulations of fishes in the pipes in various random combinations, the formation of "active constrained aggregations" (Panov, 1983), the basic cause of whose appearance would be the limitedness of the territory providing acceptable conditions. However, the makeup of the residents of different pipes is not random, and the pipes are populated to a varying extent (Tables 1, 2).

Apparently, territoriality with pronounced defence of the occupied

area is not typical for the eastern rockfish. This is confirmed by the Po/Pp values for different resident individuals, which show how often the latter were found singly in the occupied pipes. Table 2 shows that most often the residents shared the shelters with other fish. Comparison of pipe-shelters shows that there is no distinct relation between the "population" of the pipe and the presence (or absence) in it of a resident individual (Table 2). In other species of fish with pronounced territoriality /311 the more competitive individuals usually grab the best and most expansive areas of territory (Larson, 1980). We have already noted that a difference in the preference by the fish of some pipes over others could hardly be connected with the existence in the trap, with its relatively small dimensions, of a gradient in any important factors. At the same time, adjacent pipes could differ substantially in the degree of their utilization (Table 2, Figure).

Yamagishi et al., who studied the social behavior of the eastern rockfish in a specially equipped basin, also have noted the weak territoriality of this species of fish (Yamagishi et al., 1984). These same authors note the differently expressed aggressivity of the rockfish in relation to neighbors - some were attacked frequently, others were not subject to attacks at all. In our opinion, the asymmetry in reactions to neighboring fish which is observed in this species of fish, whereby some fish are subject to attack, and others not, the presence in some pipe-shelters of two residents while adjacent pipes are hardly occupied - all these facts indicate a selectivity of reaction to conspecific individuals in the eastern rockfish. By making this assumption, we can explain a number of peculiarities in the behavior and distribution of this species in natural conditions. It

is still unclear, whether this selectivity in reactions amounts to mutual habituation in frequently contacting individuals or whether there is a true individual recognition, as in family groups of cichlids (Baerends, Baerends-van Roon, 1950; Gore, 1983) and in other species of fish in territorial interactions (Fricke, 1973; Breed, Bekoff, 1981; Mauvis, 1983; Katano, 1985).

At the present time, we can only surmise what might be the preconditions for the emergence of individual recognition and whether the eastern rockfish receives thanks to it any sort of advantages in comparison with species in which the groups are anonymous (Radakov, 1972; Manteifel', 1980; Gerasimov, 1983). It is important to note that the daytime habitats for this fish are primarily places abounding in convenient shelters, not we should say, hunting territories. Other rockfish species, that feed on benthos organisms, show a typical territoriality with the occupation and defense of the areas on which they feed (Larson, 1980). In the eastern rockfish, there is no competition for food on the daytime habitats, and their accumulations are outwardly reminiscent of colonies of some small burrowing mammals.

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THE MANNER OF REFUGE UTILIZATION AND THE NATURE OF INTERRELATIONS BETWEEN SPECIMENS OF THE WHITE-EDGED ROCKFISH, *SEBASTES TACZANOWSKII* (SCORPAENIFORMES, SEBASTINAE)

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Summary

The investigation of the specimens distribution of the white-edged rockfish, *S. taczanowskii*, maintained in an experimental cage has shown that fishes are divided into three following groues according to their manner of refuge utilization: the settled, nomadic and randomic ones. Among others, there are specific specimens, «residents», which mainly demonstrate preference to one of twelve tubes offered them as refuges; the residents kept off some specimens from the tube-refuges and did not attack others inhabiting the tubes together with them. A suggestion is made about the possibility of the individual recognition in this fish species.